

ADVANCED REACTOR, FUEL CYCLE, AND ENERGY PRODUCTS WORKSHOP FOR UNIVERSITIES

R. Shane Johnson

Acting Deputy Director for Technology

Office of Nuclear Energy, Science and Technology

Welcome Remarks

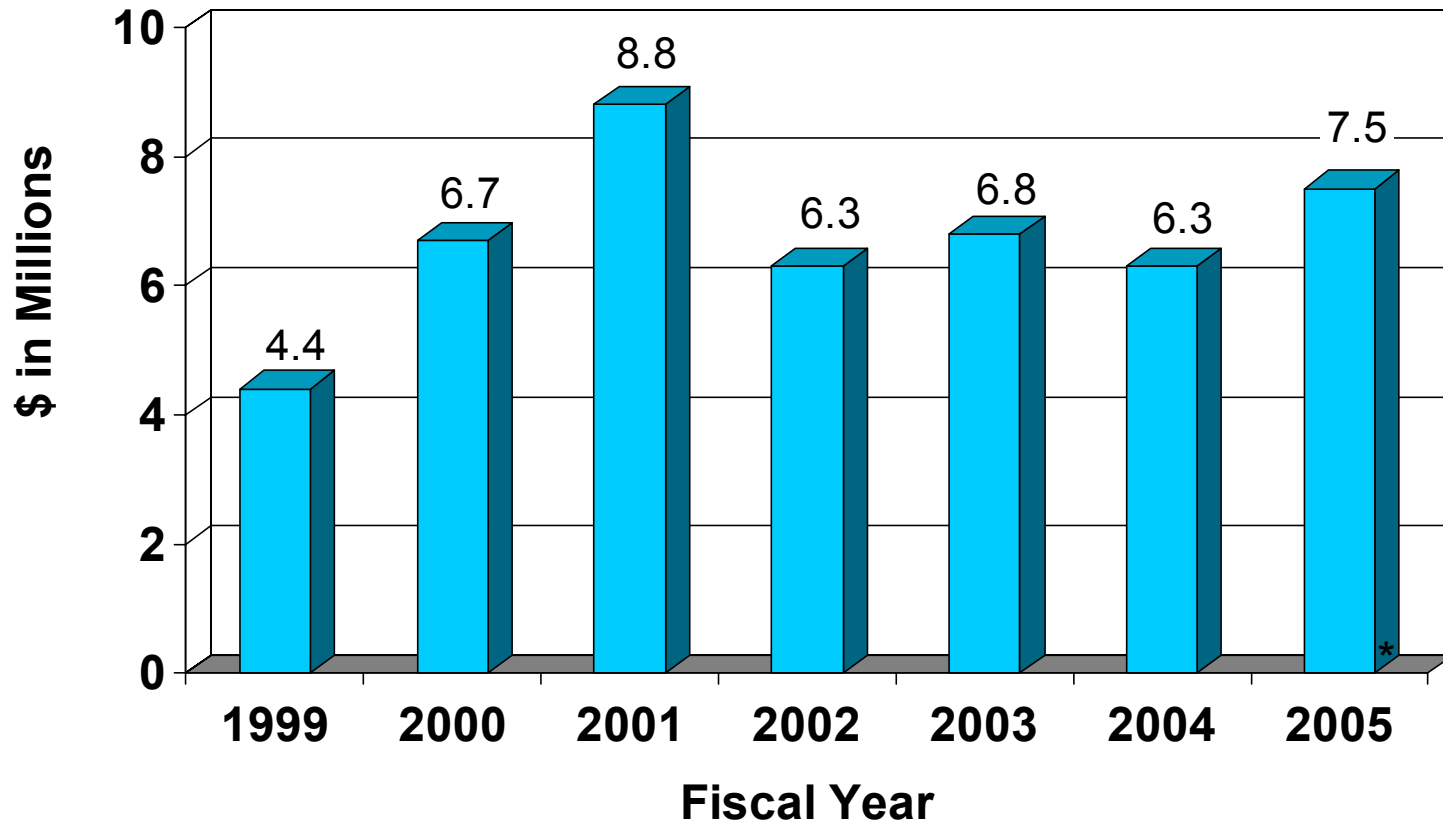
*Workshop for Universities
Hilton Hotel, Gaithersburg, MD
March 4-5, 2004*





Nuclear Energy Research Initiative

Funding for U.S. Universities



**Based on request*

ADVANCED REACTOR, FUEL CYCLE, AND ENERGY PRODUCTS WORKSHOP FOR UNIVERSITIES

Alan Waltar

**Director of Nuclear Energy
Pacific Northwest National Laboratory**

INTRODUCTION

*Workshop for Universities
Hilton Hotel, Gaithersburg, MD
March 4-5, 2004*





Purpose

- ◆ **Familiarize** U.S. Universities with the R&D requirements of the priority programs of DOE/NE:
 - GEN IV (Generation IV Nuclear Energy System Initiative)
 - AFCI (Advanced Fuel Cycle Initiative)
 - NHI (Nuclear Hydrogen Initiative)
- ◆ Provide an opportunity for the U.S. Universities to become **directly involved in an integrated teaming relationship** with the DOE and its national laboratories



Notification of Universities for this Workshop

◆ OPEN TO ALL U.S. UNIVERSITIES

- Announcement sent to ~ 15,000 faculty members
- Announcement on Federal Business Opportunities Website
- Announcement on DOE's e-Center Business & Financial Assistance Opportunities with Energy Website
- Announcement on NE web site

◆ POSITIVE ATTENDANCE RESPONSE

- ~50 Universities
- ~120 Faculty registered

◆ OTHER FACULTY INTERESTED

ADVANCED REACTOR, FUEL CYCLE, AND ENERGY PRODUCTS WORKSHOP FOR UNIVERSITIES

Charles Thompson
Program Manager
Office of Advanced Nuclear Research
Office of Nuclear Energy, Science and Technology

FY 2004 Solicitation

Workshop for Universities
Hilton Hotel, Gaithersburg, MD
March 4-5, 2004





EXPECTED FUNDING FOR FY 2004 SOLICITATION

Advanced Fuel Cycle Initiative (AFCI)	\$1.6 million
Generation IV Initiative	\$1.6 million
Nuclear Hydrogen Initiative	<u>\$0.5 million</u>
Total	\$3.7 million



Solicitation Schedule

◆ **Issue Solicitation**

April 2004

◆ **Applications Due**

May 2004

◆ **Make Awards**

September 2004



SOLICITATION ANNOUNCEMENT

- ◆ **Department of Energy's e-Center for Business and Financial Assistance web site**
 - <http://e-center.doe.gov>
- ◆ **Federal Business Opportunities web site**
 - <http://www.fedbizopps.gov>
- ◆ **Office of Nuclear Energy (NE) web site**
 - <http://www.nuclear.gov>
- ◆ **E-mail Distribution to Workshop Participants and Others**



APPLICATION INFORMATION

- ◆ **Applications will be for Cooperative Agreements vs. Grants**
 - Work will be closely coordinated with other program activities
 - Importance of meeting milestones and schedules
 - Significant government involvement through interactions with DOE and National Laboratory Managers
- ◆ **Separate application for each research topic area**
- ◆ **Project durations to be from one to three years**
- ◆ **All funds go to universities**
- ◆ **Submit applications electronically at Department of Energy's e-Center for Business and Financial Assistance web site - <http://e-center.doe.gov>**



APPLICATION REVIEW AND SELECTION PROCESS

- ◆ **Peer Review – Quality of Applications**
- ◆ **Relevance Review – DOE and National Laboratory Program Managers**
- ◆ **Management Review**

ADVANCED REACTOR, FUEL CYCLE, AND ENERGY PRODUCTS WORKSHOP FOR UNIVERSITIES

Rob Versluis

**Program Director (Acting)
Next-Generation Systems Development**

Office of Nuclear Energy, Science and Technology

Gen IV and Nuclear Hydrogen Initiatives Overview

*Workshop for Universities
Hilton Hotel, Gaithersburg, MD
March 4-5, 2004*





The Development of Nuclear Power -- Past, Present and Future

Generation I

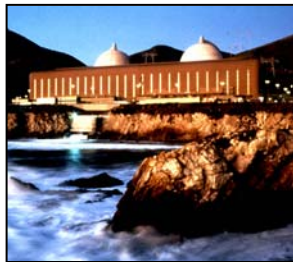
Early Prototype Reactors



- Shippingport
- Dresden, Fermi I
- Magnox

Generation II

Commercial Power Reactors



- LWR-PWR, BWR
- CANDU
- VVER/RBMK

Generation III

Advanced LWRs



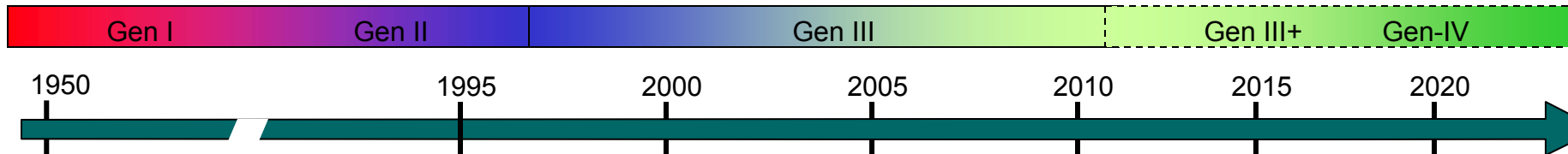
- ABWR
- System 80+
- AP600
- EPR

Near-Term Deployment

Generation I-III
Evolutionary
Designs Offering
Improved
Economics

Generation IV

- Highly Economical
- Enhanced Safety
- Minimal Waste
- Proliferation Resistant





Generation IV Initiative -- Purpose and History

- ◆ **Generation IV Initiative was established by DOE in 2000**
 - Initiative designed to lead development of Gen IV reactor systems and bring them to a state of maturity allowing for commercial deployment after 2010 but before 2030
- ◆ **Generation IV International Forum (GIF) formed in 2001**
 - The Gen IV Initiative is an international effort, with the U.S. serving as the lead. Future R&D efforts will be coordinated with other GIF nations.
- ◆ **In cooperation with GIF, U.S. DOE Nuclear Energy Research Advisory Committee (NERAC) issued the Gen IV Technology Roadmap in 2002**

GIF Countries



U.S.A.



United Kingdom



Switzerland



South Korea



South Africa



Japan



France



Canada



Brazil



Argentina



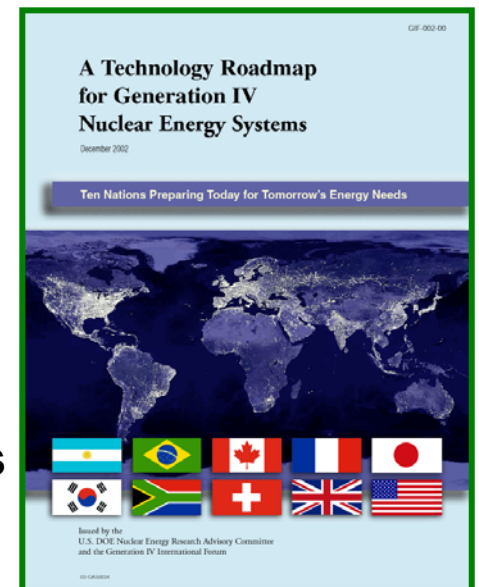
European Union



Gen IV Technology Roadmap

- ◆ Discusses the benefits, goals and challenges, and the importance of the fuel cycle
- ◆ Introduces six Generation IV systems chosen by the Generation IV International Forum for further development
 - Gas-cooled Fast Reactor (GFR)
 - Lead-cooled Fast Reactor (LFR)
 - Molten Salt Reactor (MSR)
 - Sodium-cooled Fast Reactor (SFR)
 - Supercritical Water-cooled Reactor (SCWR)
 - Very High Temperature Reactor (VHTR)
- ◆ Surveys system-specific R&D needs for all six systems
- ◆ Collects crosscutting R&D needs
 - Design and evaluation methods, materials, energy conversion
- ◆ Recognizes the need for and likelihood of nearer-term deployment, but specifies complete R&D activities

December 2002



<http://nuclear.gov/nerac/FinalRoadmapforNERACReview.pdf>



U.S. DOE Generation IV Priorities

Gen IV “Priority 1”

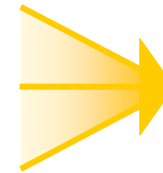
VHTR + H₂ → NGNP
SCWR

Requirements for A Next-Generation Nuclear Plant (NGNP) Project

- Collaborative with international community
- Collaborative with industry, especially utilities
- Demonstrate H₂ and direct-cycle electricity production
- Result in a commercially viable plant design

Gen IV “Priority 2”

- GFR
- LFR
- SFR

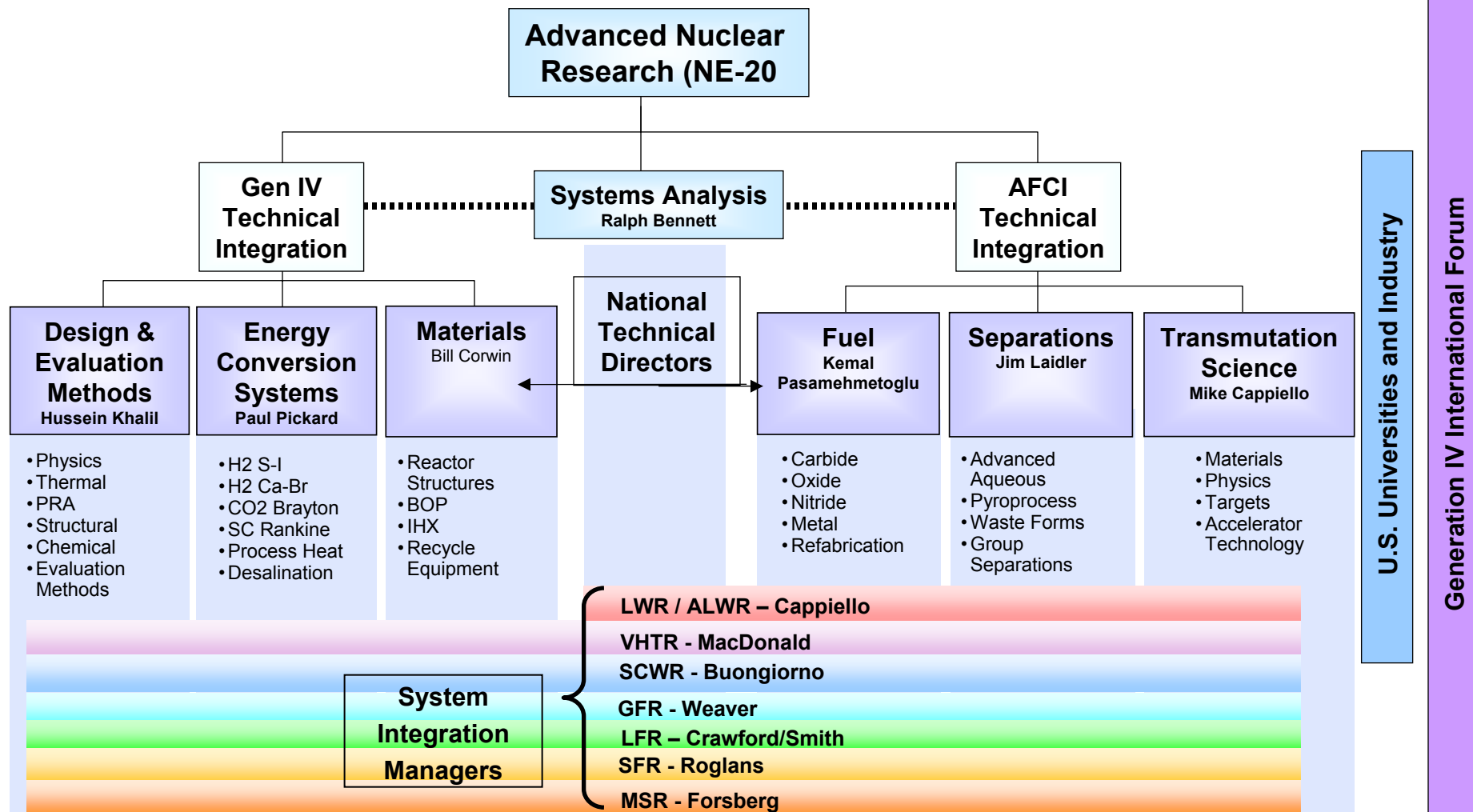


**U.S.
Fast Reactor?**

**Closely coordinated with
Advanced Fuel Cycle
Initiative**



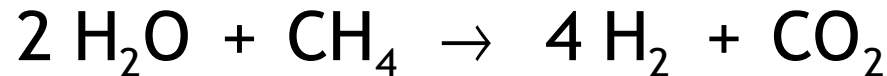
Generation IV and AFCI -- an Integrated Program





Nuclear-Assisted Hydrogen Production

- ◆ **Commercially, hydrogen is obtained from the steam reforming of methane**



- ◆ **Nuclear-assisted hydrogen production would allow for the direct cracking of water without generating CO₂ and without consuming valuable fossil fuels**



- ◆ **Above 900 °C, thermochemical cycles can be used with great efficiency (>45%)**
 - Sulfur-Iodide Cycle, Calcium-Bromine Cycle, among others
- ◆ **Similar efficiencies may be possible with steam-assisted electrolysis above 600 °C**



Systems Interface & Balance of Plant – R&D

Research and Development

- Thermochemical (TC)
- High Temperature Electrolysis (HTE)
- Systems Interface and Balance of Plant

Engineering
(commercial) Scale

50 MWt Thermochemical
1-5 MWt HTE

10 x

Pilot Plant Scale

5 MWt Thermochemical
0.5 MWt HTE

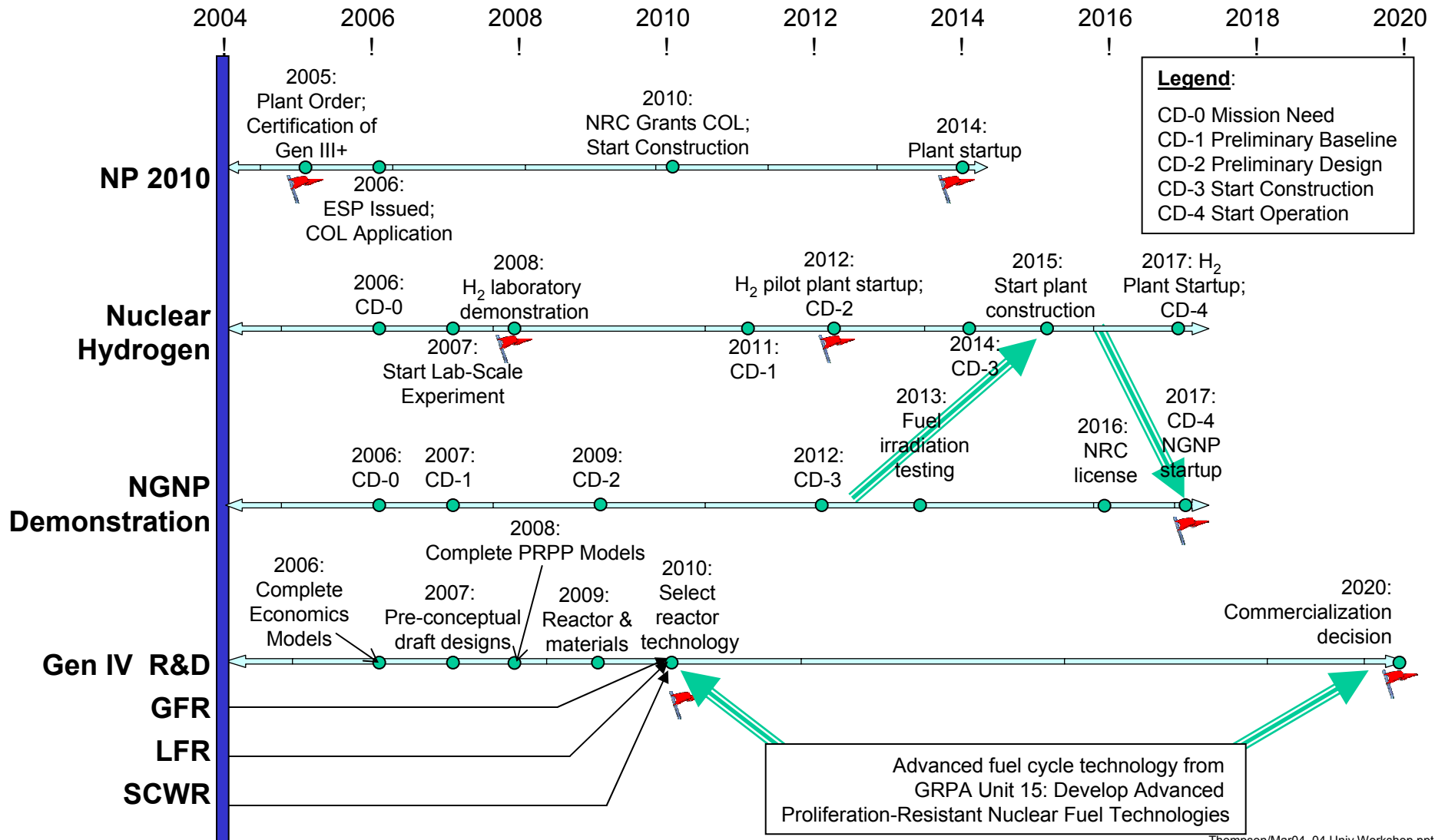
Bench & Lab
Scale, and
Materials Testing

Integrated
Lab Scale

Demonstration



Develop New Nuclear Generation Technologies



ADVANCED REACTOR, FUEL CYCLE, AND ENERGY PRODUCTS WORKSHOP FOR UNIVERSITIES

Buzz Savage
Program Director
Advanced Fuel Cycle
Office of Nuclear Energy, Science and Technology

Advanced Fuel Cycle Initiative Overview

Workshop for Universities
Hilton Hotel, Gaithersburg, MD
March 4-5, 2004

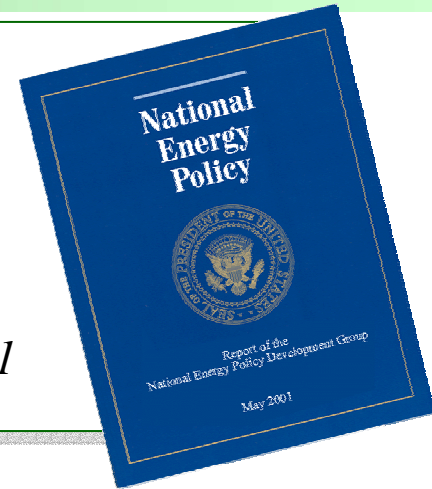




The National Energy Policy and Nuclear Power

“The NEPD Group recommends that the President support the expansion of nuclear energy in the United States as a major component of our national energy policy.”

Report of the National Energy Policy Development Group, May 2001



Calvert Cliffs Nuclear Power Plant

Recommendations:

- ◆ Support expansion of nuclear energy in the United States
- ◆ Develop advanced nuclear fuel cycles and next generation technologies
- ◆ Develop advanced reprocessing and fuel treatment technologies



Program Mission and Goal

Advanced Fuel Cycle Initiative

MISSION

Develop and demonstrate technologies that enable the transition to a stable, long-term, environmentally, economically and politically acceptable advanced fuel cycle.

GOAL

Develop advanced, proliferation-resistant fuel cycle technologies, which include spent fuel treatment, advanced fuels, and transmutation technologies, for application to current operating commercial reactors and next-generation reactors; and inform a recommendation by the Secretary of Energy on the need for a second geologic repository in the 2007-2010 timeframe.

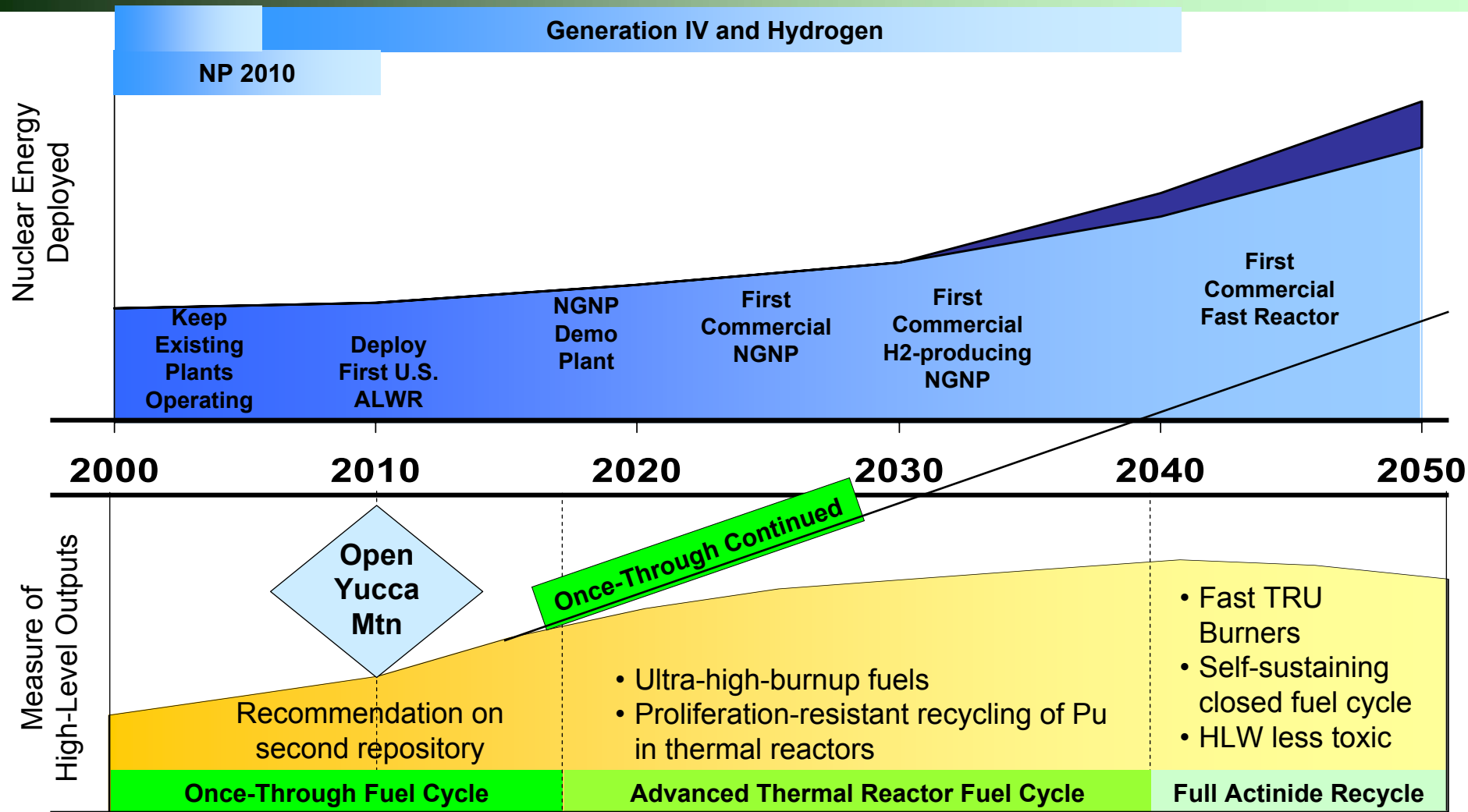


AFCI Program Objectives

- ***By 2008, develop engineering data and analysis to support a Secretarial recommendation to Congress on the need for a second U.S. repository.***
- ***By 2010, define the most technically feasible and desirable nuclear fuel cycle options and validate the new technologies necessary for their implementation during the transition to a stable long-term fuel cycle.***
- ***By 2012, complete the fuel qualification program for the Next Generation Nuclear Plant.***
- ***By 2015, develop engineering data to recommend the best option for transitioning nuclear waste management toward the future and obtain sufficient information to begin near-term implementation.***



A Long-Term U.S. Strategy for Nuclear Energy





AFCI Long-Range Strategy

2020 2030 2040 2050 2060 2070

Phase 1

Separations for Waste Management

- Uranium disposal as LLW
- Cs/Sr extracted for decay storage
- All TRUs and remaining FPs to HLW

Phase 2

Thermal Recycle of Pu/Np

- Uranium disposal as LLW
- Cs/Sr extracted for decay storage
- Pu/Np recovered for thermal recycle
- MAs and remaining FPs to HLW

Phase 3

TRUs to Dedicated Burners

- Uranium recovery for re-use
- Cs/Sr extracted for decay storage
- TRUs directed to dedicated burners
- Remaining FPs to HLW

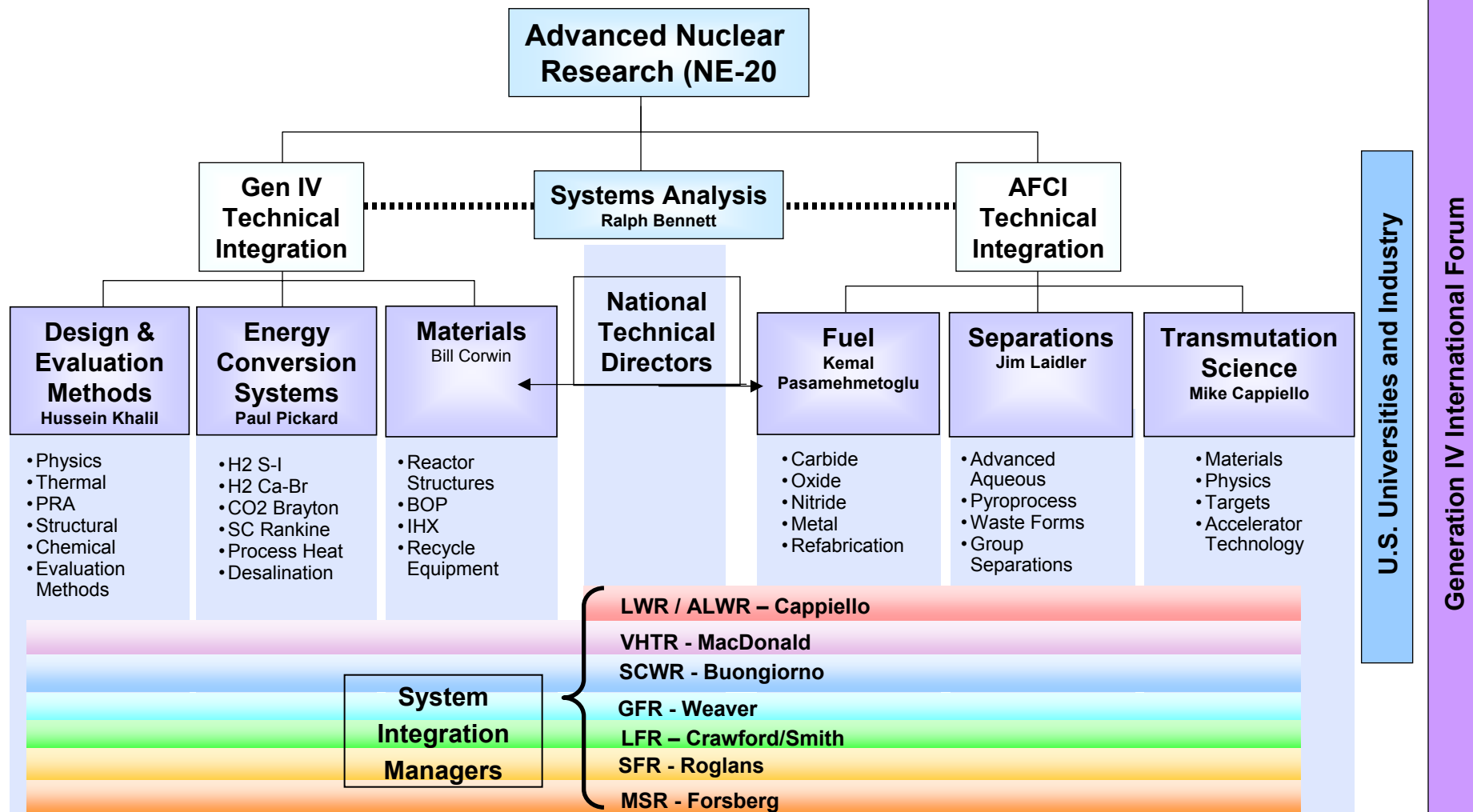
Phase 4

Entry into Gen IV Economy

- Uranium recovery for re-use
- Cs/Sr extracted for decay storage
- Actinide recycle to Gen IV reactors



Generation IV and AFCI -- an Integrated Program





AFCI Budget

◆ FY 2004 Budget

- President's Budget Request: \$63 Million
- Congressional Appropriation: \$68 Million
- Language provides \$8.5 Million in university research
 - UNLV - \$3.5 M
 - IAC - \$2 M
 - Directed University Research - \$3 M (Split between FY 2004 needs and this new program)

◆ FY 2005 Request - \$46.3 Million